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Fish Community Monitoring and Sampling Methodology Evaluation

Task 3 Report - Study Design for Comparison of Methods to Sample Silvery Minnow Abundance and Length Structure in the Main Channel and in Floodplains

Prepared for

U.S. Bureau of Reclamation, Albuquerque Area Office

Prepared by

SWCA Environmental Consultants

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Fish Community Monitoring and Sampling Methodology Evaluation

Task 3 Final Report
Study Design for Comparison of Methods to Sample Silvery Minnow Abundance and Length Structure in the Main Channel and in Floodplains

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1.0 EXECUTIVE SUMMARY

The purpose of this study design is to identify and evaluate sampling methodologies that may be used to estimate abundance and to characterize the length frequency of the Rio Grande silvery minnow (*Hybognathus amarus*; silvery minnow) in the early spring (broodstock) and autumn in the Middle Rio Grande (MRG), New Mexico (Figure 1.1).

This study design incorporates findings from an assessment report (Task 1; Widmer et al. 2010) completed for fisheries data of the MRG and a gear comparison report (Task 2; Burckhardt et al. 2010) completed for sampling gears used in other river systems. The assessment report describes data collection protocols used in the MRG, the precision of those data, and data attributes that can be used to provide insight into sampling design and methodologies. The gear comparison report describes how different gears were used, the habitats they were used in, the species detected, and the results of paired gear comparisons.

There are two parts to this study. Each part has its own study design, although there is sampling standardization that will allow for comparisons among parts (e.g., catch rate) and the ongoing monitoring data. The two parts are:

1. Comparison of methods to sample silvery minnow abundance and length structure in the main channel during early spring and fall baseflow periods (Part 1)
2. Comparison of methods to sample silvery minnow abundance and length structure on floodplains (Part 2)

The final draft of this study design will be reviewed by the U.S. Bureau of Reclamation (Reclamation) and presented to the Science Workgroup of the Middle Rio Grande Endangered Species Collaborative Program for feedback that will help to finalize the study design. This study design will be implemented in 2010 and 2011.

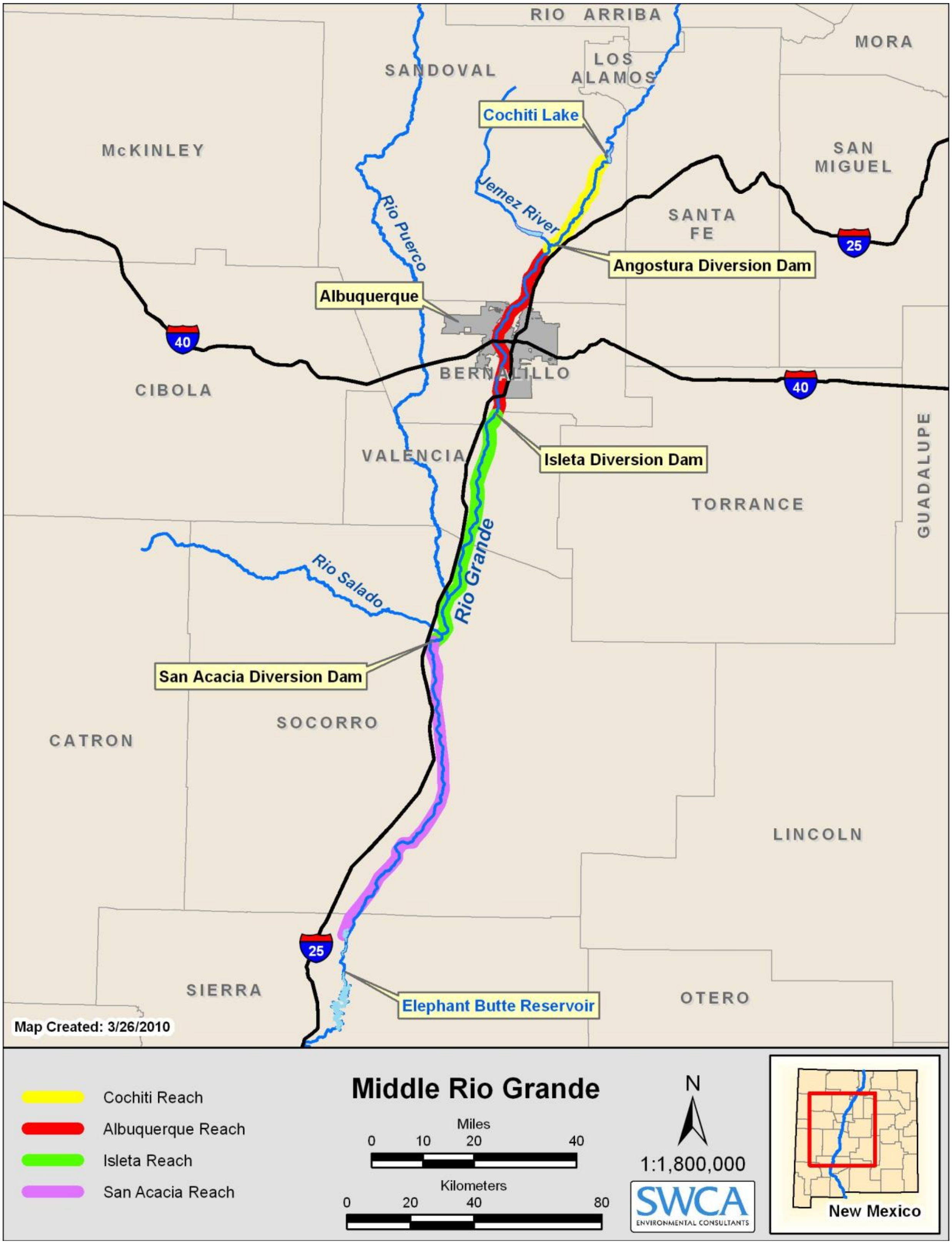

Figure 1.1. Reaches of the MRG in central New Mexico with sites used for long-term monitoring with beach seines (e.g., Dudley and Platania 2008).

2.0 BACKGROUND AND OBJECTIVES

2.1 COMPARISON OF METHODS TO SAMPLE SILVERY MINNOW ABUNDANCE AND LENGTH STRUCTURE IN THE MAIN CHANNEL DURING EARLY SPRING AND FALL BASEFLOW PERIODS (PART 1)

2.1.1 BACKGROUND

Abundance of silvery minnow has been consistently characterized using beach seines several times per year by the ongoing monitoring program (Dudley and Platania 2008). The gear comparison report supported the use of this gear type for sampling silvery minnow, ranking it highest of all the gears reviewed (Burckhardt et al. 2010). However, power and trend analyses in the assessment report find that low precision in beach seine catch rates may obscure population trends at current sample sizes (Widmer et al. 2010).

Precision of silvery minnow CPUE data may be improved by increasing sample sizes during baseflow periods. The assessment report concluded that samples of silvery minnow abundance (catch per unit effort, or CPUE) collected with beach seines during baseflow periods (e.g., September-October) were less variable than samples collected during other months or with other gears (Widmer et al. 2010). This may be because the river is largely wadeable and accessible to beach seines at this time.

Precision of silvery minnow CPUE data may also be improved by focusing the sampling effort in mesohabitats where silvery minnow are captured most frequently (i.e., low velocity habitats). This strategy would decrease the number of seine hauls with no silvery minnow, thereby decreasing sample variation. The silvery minnow is a schooling fish species and its distribution is clumped even in high quality habitat, so it is impossible to prevent samples with zero silvery minnow. This selective sampling strategy is only appropriate for monitoring if silvery minnow density in selected mesohabitats is proportional to silvery minnow density in all habitats combined.

Part 1 of this study will use beach seines during baseflow periods to compare silvery minnow catch rates in slow-velocity mesohabitats with catch rates in all habitats. This comparison will help to determine whether selective mesohabitat monitoring during baseflow periods could be a valid strategy to improve detection of changes in silvery minnow population size. Part 1 of this study will also help to validate the beach seine for capturing silvery minnow in the MRG so that the data collected by the ongoing monitoring program can be more accurately interpreted.

Validation is a process of evaluating the ability of a method to catch the fish that are actually there (Bonar et al. 2009). One approach to validating a catch index is to compare it to an unbiased estimator (e.g., mark-recapture estimates, removal estimates) (Bonar et al. 2009; Peterson and Paukert 2009). This is currently being done with removal estimates (i.e., population estimates generated from successive depletion passes using beach seines) for mesohabitats in the MRG (Dudley et al. 2007, 2008, 2009). The removal estimator calculates population estimates based on estimates of the probability of capture for individuals of the population being estimated that is specific to the method of capture, site, and environmental conditions sampled. Catch rate (CPUE) can be regressed against removal population estimates to identify sampling biases and assess the precision of CPUE as an index of fish abundance

(Peterson and Paukert 2009). This approach to validating the beach seines in the MRG is being conducted under a separate project and will not be replicated by this study.

A second approach to validating the beach seining method in the MRG is to conduct paired gear comparisons (Peterson and Paukert 2009). Gear comparison validation is complimentary to the removal estimate validation. Rather than estimate the probability of silvery minnow capture with beach seines, paired gear comparisons characterize the proportion of the silvery minnow population that may be missed or underrepresented by beach seines. The assessment report found that beach seines did not collect as many larger-bodied species, or larger-bodied silvery minnow, as seines and fyke nets (Widmer et al. 2010). A paired gear comparison would enable MRG investigators to decide whether the additional information gained using supplemental gears is worth the cost and effort given their project goals. A paired gear comparison can not be conducted with existing data; the existing data sets are not collected at approximately the same time and location, so they can not be assumed to be sampling the same fish population and species assemblage.

Part 1 of this study will conduct paired gear comparisons using beach seines and other gears that have been documented as being effective for silvery minnow (Widmer et al. 2010) or other *Hybognathus* species (Burckhardt et al. 2010). Sampling will occur in the early spring and the fall. Samples in the spring will characterize the silvery minnow broodstock. The broodstock is defined as those mature individuals in the population that are alive at the time of spawning. Estimated hatching dates from length-at-capture for 1993 through 1999 using a daily growth curve indicate that the peak of spawning generally occurs in mid-May, but may occur as early as mid-April and as late as mid-July. Since the species matures and spawns in its first year of life, the broodstock estimate should include all fish present in the population in the month prior to spawning (i.e., April 15–May 15). Sampling in the fall will characterize the entire population (including young-of-year fishes).

2.1.2 OBJECTIVES

Objectives of Part 1 of this study are to:

1) Identify sampling gears that complement the ongoing monitoring of silvery minnow abundance (CPUE), and characterize the additional information gained by using these gears.
2) Calculate the proportion of silvery minnow collected with beach seines at each site that were collected from low velocity mesohabitats. Compare proportion among sites and seasons.
3) Conduct paired gear comparisons for:
    a) Silvery minnow abundance (CPUE)
    b) Silvery minnow length structure
    c) Species detection
    d) Relative species composition
4) Summarize depth, velocity, and dominant particle size by mesohabitat type

2.2 COMPARISON OF METHODS TO SAMPLE SILVERY MINNOW ABUNDANCE AND LENGTH STRUCTURE ON FLOODPLAINS (PART 2)

2.2.1 BACKGROUND

Silvery minnow broodstock can be effectively captured on the floodplains in spring using fyke nets (Hatch and Gonzales 2008, 2010; Gonzales and Hatch 2009). For this study we define floodplains as vegetated bars and islands within the active channel that are flooded only during periods of high flow (Massong et al. 2006). Inundation of these areas may persist for weeks during spring runoff or for a short duration during monsoonal rainstorms in summer. The river reaches sufficient flows to inundate the floodplains in only about two out of five years, generally with flows in excess of 2,500 cubic feet per second (cfs) (e.g., Figure 2.1), depending on the reach of river (i.e., Albuquerque, Isleta, San Acacia). Because the floodplains do not reliably form every year and the relationship between fish on the floodplain and population size is yet unknown for the MRG, sampling of the floodplain may not provide a reliable metric for silvery minnow abundance.

The assessment report (Widmer et al. 2010) has found that silvery minnow captured from floodplains with fyke nets are significantly larger (standard length) than those caught with seine nets in the main channel. Part 2 of this study will include sampling of silvery minnow on the floodplain (if available) for comparison of fish lengths and catch rates among commonly the used gear types to sample the MRG fish community (i.e., seine nets, fyke nets, and electrofishing).

2.2.2 OBJECTIVES

Objectives of Part 2 of this study are to:

1) Compare length structure of silvery minnow broodstock collected on the floodplain among three principal gear types used to sample the MRG fish community.

2) Collect data on silvery minnow sex and condition

3) Conduct paired gear comparisons for:

   a) Silvery minnow abundance (CPUE)

   b) Silvery minnow length structure

   c) Species detection

   d) Relative species composition

   4) Conduct paired gear comparison

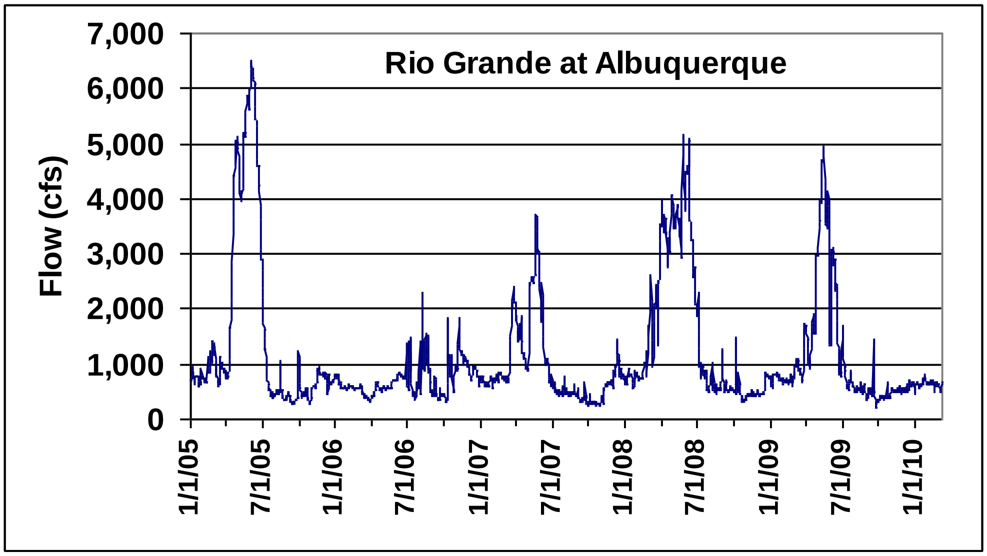

Figure 2.1. Flow of the Rio Grande at Albuquerque from January 1, 2005–March 9, 2010 (U.S. Geological Survey Gage 08330000).

3.0 STUDY DESIGN AND SAMPLING METHODS

The study designs and sampling methods for each part of the study are described separately below.

3.1 COMPARISON OF METHODS TO SAMPLE SILVERY MINNOW ABUNDANCE AND LENGTH STRUCTURE IN THE MAIN CHANNEL DURING EARLY SPRING AND FALL BASEFLOW PERIODS (PART 1)

3.1.1 TIMING

Samples will be collected two times per year, once in the early spring and once in the fall.

EARLY SPRING

The MRG generally remains at baseflow through about the first week of March, so broodstock sampling should occur in February or early March (Figure 3.1). River flows during April and May are changing daily or are generally too high to use the seining technique identified in the assessment report as the most reliable for sampling the species (i.e., beach seines at baseflow). Flows generally increase or are unstable until about the first of July, which is after the majority of silvery minnow reproduction is complete.

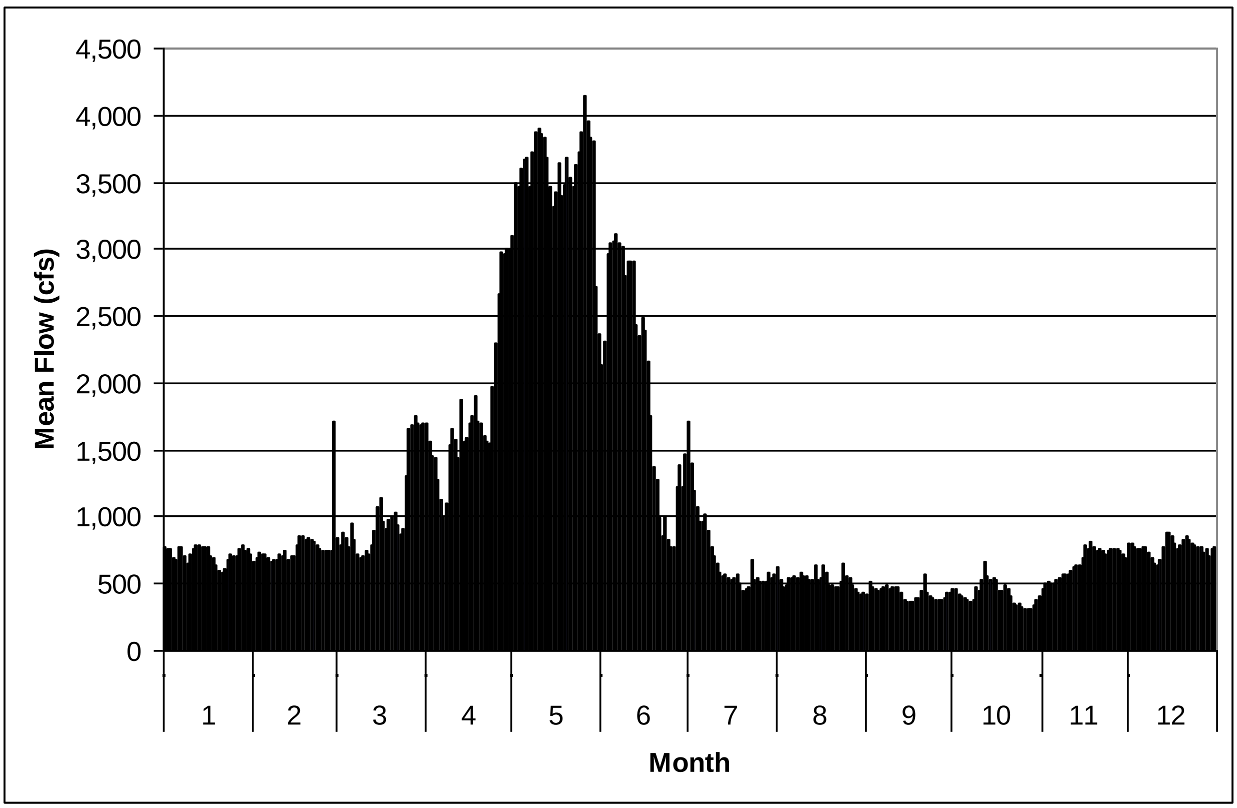

Figure 3.1. Mean daily flow for 2006–2009 by month (U.S. Geological Survey Gage 08330000).

An estimate of the silvery minnow broodstock using seines during a stable low flow is unlikely for 2010 due to the timing of finalization of this report and study design. However, the option will be left for SWCA Environmental Consultants (SWCA) to sample in April following the Science Workgroup meeting if the river remains at low flow (<1,000 cfs). Otherwise, sampling for broodstock at baseflow in early spring will not occur until about February–March 2011.

FALL

Flows in the MRG stabilize in July and decrease to baseflow levels in October and early November before rising again. Fall samples of silvery minnow abundance will occur during this baseflow period (late September–October) in 2010.

3.1.2 GEARS

Active and passive gear types will be used in Part 1 of this study to facilitate paired gear comparisons and validation of the beach seine method for the MRG.

ACTIVE

The active gear types used in this study will be electrofishing and seining. Both these gears have been used effectively for fish sampling in the MRG (Widmer et al. 2010).

<u>Electrofishing</u>—The majority of electrofishing samples will be collected with a backpack electrofishing unit (e.g., LR-24 Backpack Electrofisher, Smith Root, Inc.) for comparison to beach seine samples. This electrofishing gear is portable and capable of sampling shallow waters at baseflow. Each electrofishing sample will cover the entire area of a distinct mesohabitat unit, with the crew moving in an upstream direction. Stunned fish will be netted and promptly removed from electricity, either transferred to an aerated holding container (live well or 19-L [5-gallon] bucket).

<u>Seines</u>—The majority of seine samples will be collected with small beach seines (3.1 × 1.8 m [10 × 6 feet] with mesh approximately 5 mm [3/16 inch]) in a downstream direction, consistent with the protocol currently used for the ongoing silvery minnow monitoring program (Dudley and Platania 2008). A longer bag seine (e.g., 15.24 ×1.8 m [50 × 6 feet] with mesh approximately 5 mm [3/16 inch]) will also be experimentally tried in mesohabitats that are free of woody debris. One end of the bag seine will be anchored on shore. The net will be extended fully upstream along the bank and then swiftly pulled through the water in a 180 degree arc back to the bank. The lead line of the seine will be pulled in slowly, maintaining contact with the stream bottom, so that the fish are concentrated in the bag of the seine.

PASSIVE

<u>Fyke nets</u>—Fyke nets are effective for capturing adult silvery minnow in floodplain habitats (Hatch and Gonzales 2008, 2010; Gonzales and Hatch 2009), as well as *Hybognathus* species in the main channel habitats of other river systems (Burckhardt et al. 2010). Fyke nets will be used in slow and deep main channel habitats of the MRG at baseflow. The fyke nets used in this study will be rectangular with one wing in the center of the opening and approximately 6.44-mm (¼-inch) mesh. In this configuration, the wing will intercept fish moving both upstream and downstream. Fyke nets will be set perpendicular to shoreline with the wing extended to the

shoreline, where possible. Fyke net sets during the day will last 4 to 6 hours. Fish will be released downstream of the sampling site.

SWCA proposes to conduct all sets during the daytime, so that nets can be checked frequently and incidental take of silvery minnow can be minimized. Species composition and catch rates from daytime sets may differ from nighttime and crepuscular sets, but this difference will not be characterized as part of this study.

3.1.3 LOCATIONS AND REPLICATES

SITES

Five representative 1-km (0.6-mile) sites will be selected, one from each of the major channel geomorphology types in the MRG (Massong et al. 2006): moderate incision, low to moderate incision, no recent incision, high incision, and slightly aggrading. Sites will be located near existing monitoring sites but far enough away (>2km) so that sampling will not affect the outcome of the ongoing monitoring program. There are two sites proposed in the Albuquerque Reach (Figure 3.2), two in the Isleta Reach (Figure 3.3), and one in the San Acacia Reach (Figure 3.4).

BLOCKS

Each 1-km (0.6-mile) site will be divided into three 300-m-long (984-foot-long) blocks with 50-m (108-foot) breaks between them. Each block will randomly be assigned to sampling by 1) electrofishing, 2) beach seines, or 3) fyke nets and long bag seine.

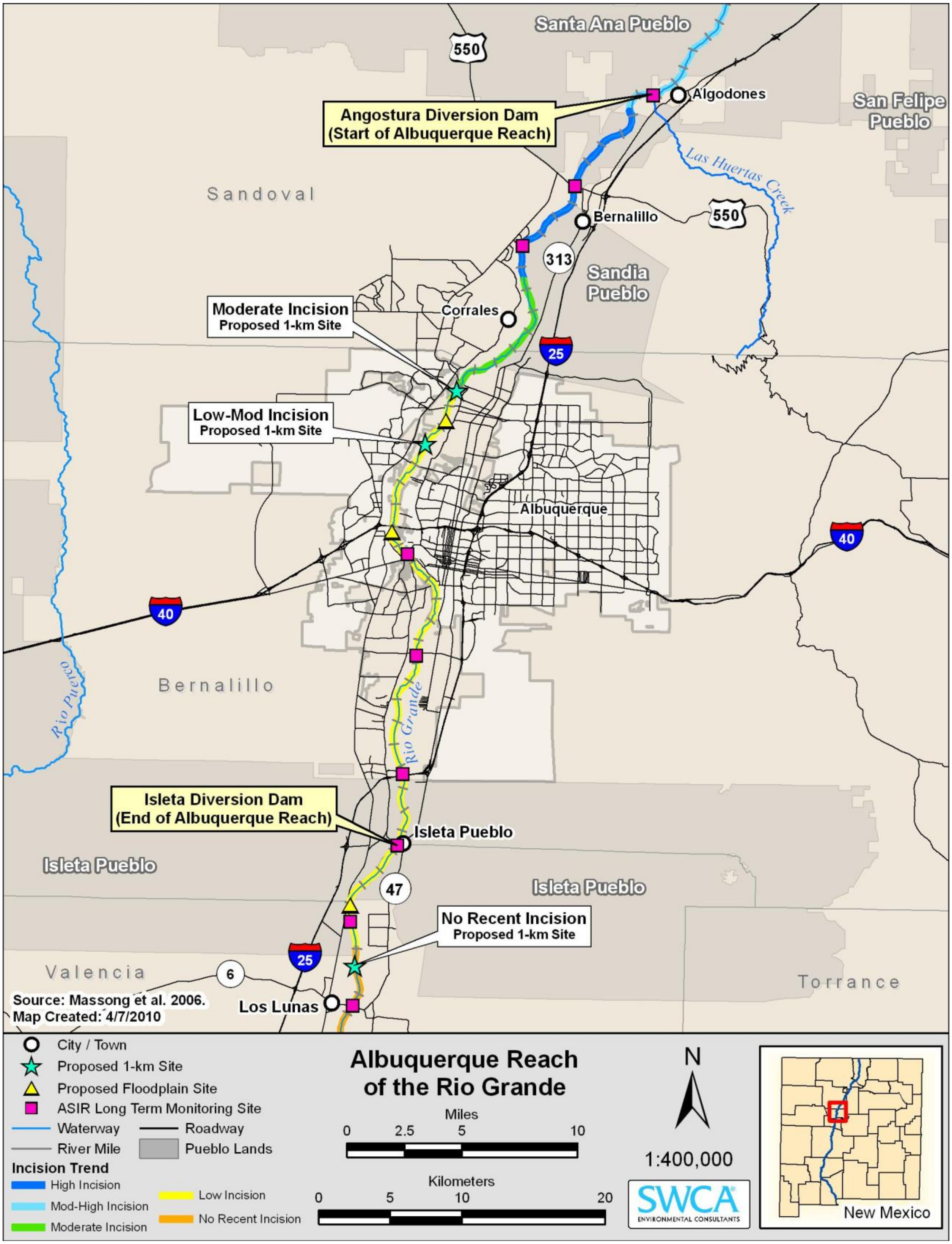

Figure 3.2. Proposed sampling sites in the Albuquerque Reach.

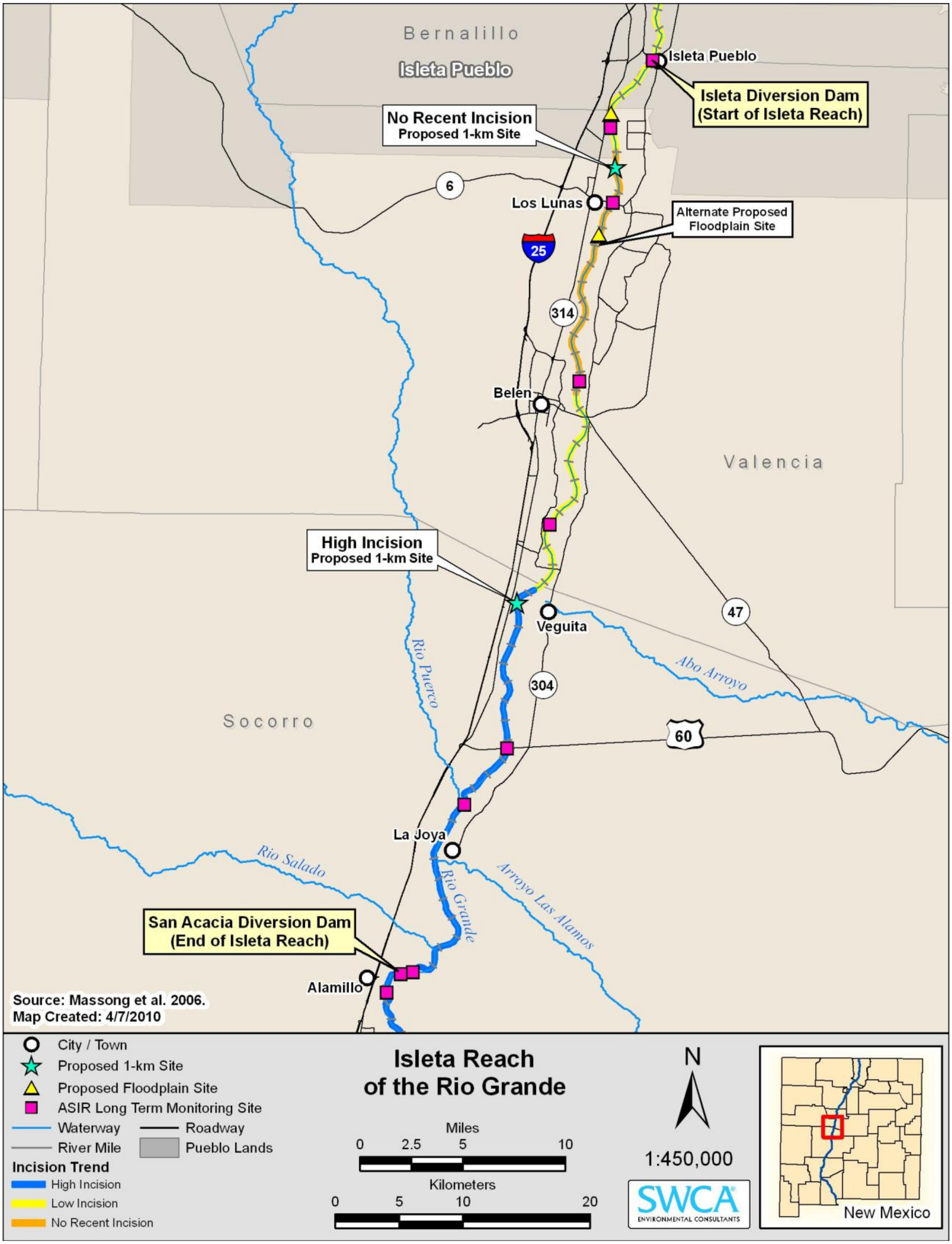

Figure 3.3. Proposed sampling sites in the Isleta Reach

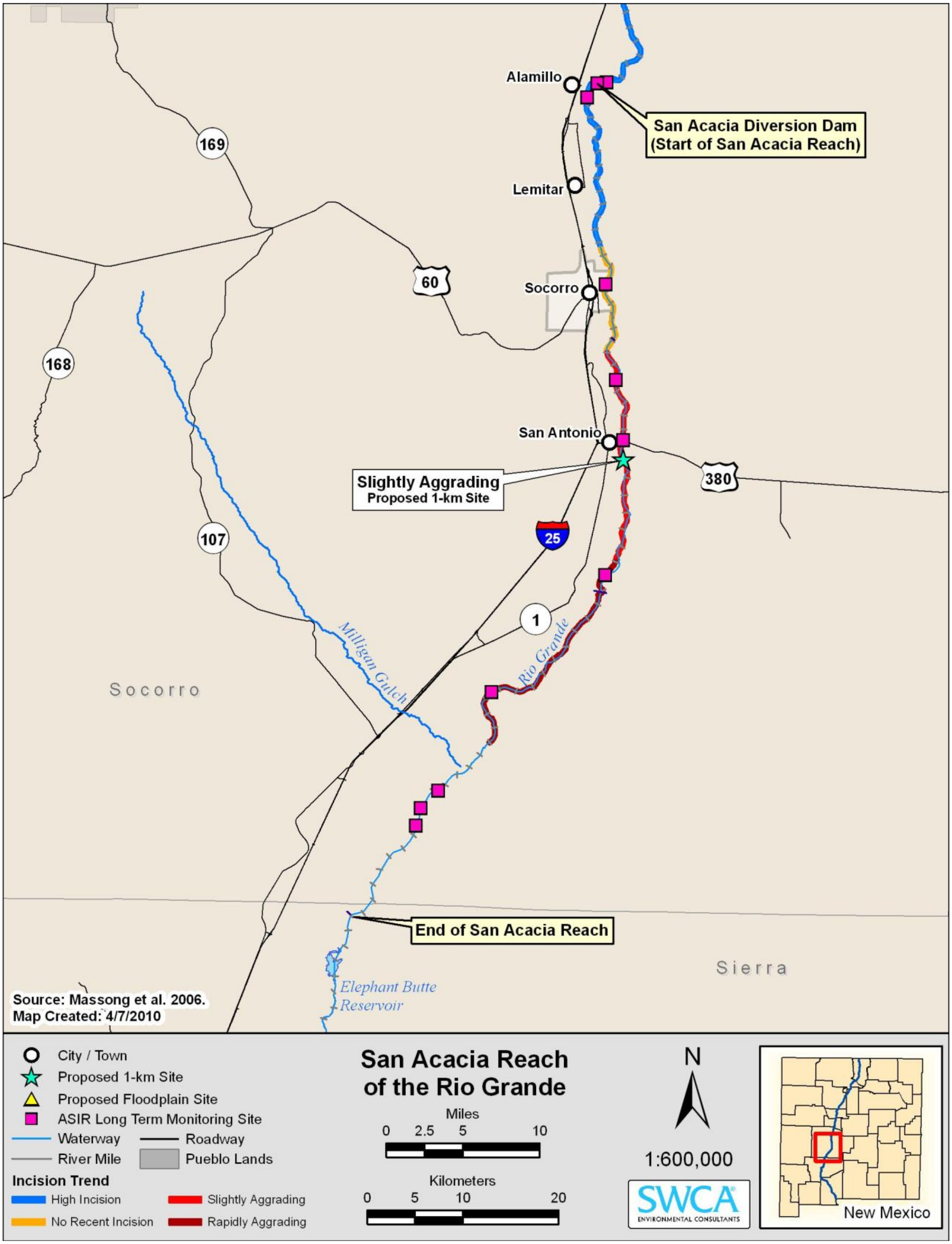

Figure 3.4. Proposed sampling sites in the San Acacia Reach.

SAMPLES

<u>Electrofishing</u>—Within the electrofishing block, distinct mesohabitats will be sampled in proportion to their occurrence with each mesohabitat type being sampled at least once. Mesohabitats will be visually identified according to definitions adopted from Armantrout (1998) and currently used by the U.S. Fish and Wildlife Service (USFWS, Remshardt 2008). A minimum of 10 mesohabitats will be sampled using a backpack electrofisher. Selected units will be spaced to avoid overlap of sample areas, minimize potential disturbance to fish in other seine locations, and reduce the likelihood of multiple captures of the same fish (Kehmeier et al. 2007).

<u>Beach Seines</u>—Within the beach seine block, distinct mesohabitats will be visually identified and sampled in proportion to their occurrence with each mesohabitat type being sampled at least once. A minimum of 20 distinct mesohabitat samples will be collected consistent with protocols used by the ongoing mesohabitat program.

<u>Fyke Nets and Long Bag Seine</u>—Within the fyke net and long bag seine block, three to four fyke nets will be set in areas with depths greater than 0.20 m (0.66 foot) and with slow current velocities, such as backwaters, floodplains, and near eddy habitats. Long bag seines will be used to sample either during fyke net sets or after the completion of fyke net sets. This experimental gear type will be used wherever it is possible to deploy them (e.g., free of woody debris) and not likely to influence fyke net catch rate. Where possible, samples with the long bag seine will be restricted to one mesohabitat type, but it is likely that samples collected with this larger gear may sometimes encompass multiple mesohabitat types.

3.1.4 DATA COLLECTION

SEINES

For each seine sample collected, the type of seine (beach seine or long bag seine), the time of the sample, and the mesohabitat type will be recorded. The area seined will be estimated by multiplying the distance seined by the effective seine width (Remshardt 2008). For each sample, all fish will be identified to species and counted. Standard length (mm) will be collected from captured silvery minnows. After processing, fish will be released to the mesohabitat where they were captured.

For all methods, sampled fish will be identified in the field using taxonomic keys provided in Sublette et al. (1990); phylogenetic classification will follow Nelson et al. (2004). Head-mounted jeweler's magnifiers will be used to aid in fish species identification. Any incidental silvery minnow mortalities caused by sampling will be preserved for museum collection.

ELECTROFISHING

For each electrofishing sample collected, the type of electrofishing gear (i.e., barge or backpack), the time fished (seconds of electricity applied), and the area sampled will be recorded. All electrofisher settings will be recorded, as well as the mesohabitat type sampled. For each sample, all fish will be identified to species and counted, and standard length (mm) will be collected from silvery minnows. After processing, fish will be released to the mesohabitat where they were captured.

FYKE NETS

For each fyke net sample, the soak time will be recorded in hours and minutes each time the net is emptied as well as the start and end time of the sample. The mesohabitat sampled will also be recorded. For each sample, all fish will be identified to species and counted, and standard length (mm) will be measured for silvery minnows. Unless fyke net sampling has been concluded for the day, fish will be released downstream of the site (i.e., downstream of all three blocks). If sampling has concluded for the day, fish will be released to the mesohabitat where they were captured.

WATER QUALITY

Water quality measurements will be collected using handheld meters at the beginning and end of each sampling day in the electrofishing block. Measurements made with a YSI 556 handheld multiprobe meter (Yellow Springs Instruments, Inc., Yellow Springs, Ohio) will include temperature (degrees Celsius), dissolved oxygen (parts per million [ppm]), conductivity (microsiemens per centimeter), salinity (parts per thousand [ppt]), and hydrogen ion concentration (pH). A HANNA portable microprocessor turbidity meter (HANNA Instruments, Inc., Woonsocket, Rhode Island) will be used to measure turbidity (Formazin Turbidity Unit [FTU])

GLOBAL POSITIONING SYSTEM

Trimble GeoXT handheld GPS units (Trimble Navigation Limited**,** Sunnyvale, California) with sub-meter accuracy will be used to record the upstream and downstream boundaries of each block at each site. Mesohabitat maps will be made of the beach seine block at each site. All mesohabitats in the block will be delineated and labeled with the GPS unit and sketched on aerial photographs of the channel.

Point locations of all the mesohabitats sampled will be recorded. The fish collection crews will leave a pin flag in the center of mesohabitats sampled with the mesohabitat type, the sample gear used, and time sampled. This information will be recorded with the GPS record of the location for accurate cross-referencing during data processing.

MESOHABITAT MEASUREMENTS

Mesohabitat measurements will be collected after each fish sample has been collected next to the pin flag left by the fish sampling crew. Water depth and water velocity will be measured using a Marsh-McBirney Flo-Mate portable velocity meter (Hach Company, Frederick, Maryland) and top-setting wading rod. The dominant particle size of the substrate (e.g., sand, small gravel, cobble, etc.) will be recorded, as well as presence and type of structure (e.g., woody debris, vegetation, boulders, etc.).

3.1.5 CREW

A field crew of nine people will be required to sample one site per day. The crew can be broken up into three groups. The first is a seining crew of three people that will operate the beach seines and long bag seines. The second is an electrofishing and fyke net crew of four to operate the barge or backpack electrofisher and to set and pull fyke nets. A third crew of two will collect the water quality measurements, GPS data, and mesohabitat measurements.

3.1.6 ANALYSIS

CATCH PER UNIT EFFORT

Seine sample CPUE will be expressed as fish per 100 m^2 seined. Electrofishing sample CPUE will be expressed as fish collected per seconds of electricity applied and fish per 100 m^2 sampled. Fyke net sample CPUE will be expressed as fish collected per hour of soak time (Quinn and Deriso 1999; Hubert and Fabrizio 2007).

MESOHABITAT, SITE, AND GEAR COMPARISONS

Comparisons of CPUE (specifically catch per area sampled) will be conducted among sites and among mesohabitat types for the same gear type. Comparisons of catch per area sampled, species collected, and length of fishes collected will be compared among electrofishing and seine gear types for mesohabitats within a site and across sites. Because CPUE data are usually highly skewed by large numbers of samples with no fish, non-parametric statistics will likely be used for these comparisons (Widmer et al. 2010).

SIZE STRUCTURE

Length-frequency histograms will be constructed for silvery minnow by gear type and compared among sites and gears.

SPECIES DETECTION

The species collected and the relative species composition (i.e., proportional [%] numerical abundance of species within the catch) will be compared among gears and sites. Paired t-tests (or an analogous non-parametric test) will be used to compare species richness among the three major gear types used.

ENVIRONMENTAL PARAMETERS

Measurements of environmental parameters (e.g., water depth, water velocity, substrate size) will be summarized by mesohabitat type, site, and season. These measurements will be stored with the catch rate data so that they will be available for use in future habitat characterization or habitat utilization analyses.

PRECISION IN ABUNDANCE MONITORING

Silvery minnow abundance (CPUE) and precision (Coefficient of Variation [CV]) from beach seine samples will be calculated for each site and for all sites combined using 1) samples from all mesohabitat types; and 2) samples from low-velocity mesohabitat types only (e.g., pools, embayments, backwaters, plunges). Correlation of these CPUE calculations will provide additional information on whether samples of silvery minnow abundance in low velocity habitats are proportional to silvery minnow abundance in the site. Trend analysis using these CV calculations will provide information on whether selective sampling of low-velocity habitats can increase the power of the monitoring effort to detect changes in population size.

Mesohabitat-specific sampling precision will also be calculated. Sample sizes and sample distribution needed to achieve various levels of precision (e.g., CV <0.15) and resource detection (e.g., <40% change in annual population density) will be determined. Alternative sampling scenarios and designs will be assessed to determine optimal sampling schemes for the MRG.

Silvery minnow monitoring data collected during 1993 to 2009 may be used with the samples collected during this study to increase the robustness of these comparisons.

SAMPLING COST AND LOGISTICS

The time spent per sample collected, per fish collected, and per silvery minnow collected will be calculated and compared among gear types. Additionally, the relative cost (e.g., price of the gear, number of people required for a crew), sampling considerations, and sampling limitations will be summarized by gear type.

3.2 COMPARISON OF METHODS TO SAMPLE SILVERY MINNOW ABUNDANCE AND LENGTH STRUCTURE ON FLOODPLAINS (PART 2)

3.2.1 TIMING

Sampling will occur during peak spring flows when floodplains are most likely to be inundated (approximately May 1–June 1, 2010). Samples will be collected twice weekly for three weeks.

3.2.2 GEARS

Both active and passive gears will be used in Part 2 of the study to enable paired gear comparisons.

PASSIVE

Fyke nets will be used on every sampling occasion. A minimum of three fyke nets will be set per floodplain site for 4 to 6 hours. The nets used will be D-frame, double wing fyke nets with 0.5 × 0.5–m (1.6 × 1.6–foot) hoops and 6.44-mm (¼-inch) mesh. Fyke nets will be set facing downstream in areas with water depths greater than 0.20 m (0.66 foot) and may be set in areas with relatively heavy vegetation or areas with little vegetation. Nets will be placed with sufficient distance between them so that catches from each net may be considered independent replicates from each floodplain site. Fyke nets will be set during daylight hours.

ACTIVE

The two active gears used to sample the floodplain in Part 2 of the study are beach seines and backpack or barge electrofishing. These gears will be alternated over sampling events so that each is used once per week. If heavy vegetation is present in the floodplain (e.g., inundated willows), the seine samples may be eliminated and sampling will occur only one time per week with fyke nets and electrofishing.

The beach seine is identical to that used in Part 1 of the study (3.1 × 1.8 m [10 × 6 feet] with mesh approximately 5 mm [3/16 inch]). Electrofishing samples will be collected with a small electrofishing barge or a backpack electrofishing unit for comparison to fyke net and seine samples. Care will be exercised to reduce the potential for electrofishing-induced injuries to fish resulting from extended or repeated exposure to electric current. Fish that are temporarily stunned by electrofishing will be captured with dip nets or with seines. Fish will be removed from the river immediately upon capture and placed in 19-L (5-gallon) buckets with aerated river water. Fish will be transported to large aerated containers for processing immediately after the completion of sampling.

3.2.3 LOCATIONS AND REPLICATES

Three floodplain areas will be sampled: two in the Albuquerque Reach (Figure 3.2) and one in the Isleta Reach (Figure 3.3). If the floodplain does not inundate in 2010, low-velocity main channel habitats adjacent to these sites will be sampled instead.

Fyke net locations will be kept as constant as possible, although adjustments to net position may be required as environmental conditions change (e.g., water depth or extent). Electrofishing and beach seine samples will be collected alternately from pre-determined polygons with known area during each sampling event.

3.2.4 DATA COLLECTION

FYKE NETS

For each fyke net sample, the soak time will be recorded in hours and minutes each time the net is emptied, as well as the start and end time of the sample. For each sample, all fish will be identified to species and counted, and standard length (mm) and weight (0.1 g) will be collected from all silvery minnows. Observations of fish sex and reproductive condition will be noted. Any incidental silvery minnow mortalities caused by this or any other sampling method will be preserved for museum collection. After processing fish will be released upstream of the fyke net they were collected from, where they will not be subject to capture by the same fyke net a second time.

BEACH SEINES

For each seine sample collected, the time of the sample, the polygon number, and the area of the polygon will be recorded. For each sample, all fish will be identified to species and counted, and standard length (mm) and weight (0.1 g) will be collected from all silvery minnows. Observations of sex and reproductive condition will be noted. After processing, fish will be released to the polygon where they were captured.

ELECTROFISHING

For each electrofishing sample collected, the type of electrofishing gear (i.e., barge or backpack), the time fished (seconds of electricity applied), and the area of the polygon sampled will be recorded. All electrofisher settings will be recorded. For each sample, all fish will be identified to species and counted, and standard length (mm) and weight (0.1 g) will be collected from all silvery minnows. After processing, fish will be released to the mesohabitat where they were captured.

WATER QUALITY

Water quality measurements will be collected on the floodplain using handheld meters at the beginning and end of each sampling day. Measurements made with a YSI 556 handheld multiprobe meter will include temperature (degrees Celsius), dissolved oxygen (ppm), conductivity (microsiemens per centimeter), salinity (ppt), and hydrogen ion concentration (pH). A HANNA portable microprocessor turbidity meter will be used to measure turbidity (FTU).

GLOBAL POSITIONING SYSTEM

Point locations of all samples will be recorded with a Trimble GeoXT handheld GPS unit with sub-meter accuracy. The sampling polygons will also be delineated by GPS for area calculation.

MESOHABITAT MEASUREMENTS

Mesohabitat measurements will be collected after each fish sample has been collected. Water depth and water velocity will be measured using a Marsh-McBirney Flo-Mate portable velocity meter and top-setting wading rod. The dominant particle size of the substrate (e.g., sand, small gravel, cobble, etc.) will be recorded as well as presence and type of structure (e.g., woody debris, vegetation, boulders, etc.).

3.2.5 CREW

Sampling will require a crew of three to four people. Two to three people will collect fish; the other person will collect water quality and GPS measurements, assisting the fish crew as necessary.

3.2.6 ANALYSIS

CATCH PER UNIT EFFORT

Seine sample CPUE will be expressed as fish per 100 m^2 seined. Electrofishing sample CPUE will be expressed as fish collected per seconds of electricity applied and fish per 100 m^2 sampled. Fyke net sample CPUE will be expressed as fish collected per hour of soak time (Quinn and Deriso 1999; Hubert and Fabrizio 2007).

COMPARISONS OF CATCH RATE BY GEAR

Catch per unit effort, species richness, and silvery minnow size will be compared among the three gear types using regression or correlation analyses. The proposed floodplain sampling scheme will result in a minimum of 27 paired fyke and electrofishing and fyke and seining samples (3 sites × 3 sample areas/site × 3 weeks). Since samples will be collected using two different gears at approximately the same time, these gears can be assumed to be sampling the same fish population and assemblage.

COMPARISONS OF SPECIES DETECTION BY GEAR

Paired t-tests (or an analogous non-parametric test) will be used to compare species richness among the three gear types used.

SIZE STRUCTURE

Size of silvery minnow will be compared among tested gear types. Size comparisons will not be made between silvery minnow collected from floodplain and main channel habitats, only among gear types used to sample the same habitat (e.g., floodplain). Length-frequency histograms will be constructed for silvery minnow by gear type and compared among sites and gears.

4.0 SAMPLING SCHEDULE OVERVIEW

The schedule for implementing the entire study design is provided in Table 4.1.

- For sampling fish at spring baseflow, we propose to sample during April, if the river remains at below about 1,000 cfs. Otherwise, baseflow seining of broodstock will not take place until about February 2011.
- For sampling fish at fall baseflow, we propose to conduct sampling in late September and October 2010 prior to the onset of higher fall discharge following the irrigation season.
- For sampling floodplains, we propose to conduct sampling over the period of about May 1 to June 20, 2010.

Table 4.1. Schedule for Sample Design

Activity	2010										2011		
	Mar	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**
Spring Baseflow Sampling (Part 1)		?										X	X
Fall Baseflow Sampling (Part 1)							X	X	?				
Floodplain Sampling (Part 2)			X	X									

5.0 DATA MANAGEMENT AND ANALYTICAL SOFTWARE

5.1 DATA MANAGEMENT

Field data forms will be prepared to facilitate the recording of field data. A spreadsheet database (Microsoft Access) will be developed for the storage, analysis, and retrieval of fish and associated sampling data.

5.2 DATA ANALYSIS SOFTWARE

Statistical analyses will be done with SAS (SAS Institute Inc., Cary, North Carolina), R 2.10.1 (R Development Core Team 2010), Statistix 9 (Analytical Software, Tallahassee, Florida) or Systat 12 (Systat Software Inc., Chicago, Illinois).

6.0 REGULATORY COMPLIANCE

All study components will be conducted in compliance with all applicable environmental regulations and permitting requirements. Consistent with the Endangered Species Act of 1973, as amended, scientific collecting permits will be obtained from the USFWS to capture, handle, and release silvery minnow. Scientific collecting permits will also be procured from the New Mexico Department of Game and Fish. This study will not require compliance with the National Environmental Policy Act of 1969, the Clean Water Act, the National Historic Preservation Act, or other environmental legislation or regulations.

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